

CHAPTER 19

GENERATORS

19-1. Minimum maintenance for generators

The tables located at the end of this chapter indicate items that must be performed to maintain systems and equipment at a minimum level of operational readiness. The listed minimum action items should be supplemented by manufacturer-recommended maintenance activities and procedures for specific pieces of equipment. Maintenance actions included in this chapter are for various modes of operation, subsystems, or components. Table 19-1 provides information on typical generator maintenance. Table 19-2 provides maintenance information for generators. Table 19-3 provides maintenance information for system controls.

19-2. General maintenance for generators

Preventive maintenance is a periodic checking and testing of equipment. The following discusses minimum preventive maintenance tasks as indicated in the tables. The frequency of the tasks is indicated in the tables.

a. Typical maintenance tasks. This section presents general instructions for maintaining generator systems.

(1) Personnel should review past maintenance records to find repair patterns. These records may point to certain components that should be closely inspected during performance of preventive maintenance.

(2) Review operator records concerning electrical load connected to the generators, and compare with equipment ratings. Operator records regarding generator lubrication and operating temperatures should also be reviewed, as well as any documented abnormal circumstances associated with generator or control system operation.

(3) Generator system equipment should be thoroughly inspected and all discrepancies reported to the shift supervisor.

(a) Inspect to ensure that warning signs exist. Replace as required.

(b) Inspect enclosures for damage, unauthorized openings, and corrosion of metallic objects. Repair and paint as required.

(c) Inspect air passages and remove any blockage.

(d) Inspect, investigate, and solve conditions for unusual odors.

(e) As equipment is operated and tested, listen, investigate, and solve conditions for unusual noises.

- (f) Inspect electrical connections for degradation; repair as required.
 - (g) Inspect electrical insulation for discoloration and degradation; repair as required.
 - (h) Inspect, investigate, and solve conditions causing carbon tracks.
 - (i) Inspect equipment grounding components such as conductors and connections; repair as required.
 - (j) Inspect insulators for damage; replace as required.
 - (k) Inspect locking devices; repair as required.
- (4) To clean equipment remove debris, dirt, and other foreign objects from all components, housings, cabinets, panels, etc.
- (5) All electrical connections should be torqued to the proper design value.
- (6) Verify operation of space heaters and control thermostat in generator or control panels. Check thermostat set point for proper setting.
- (7) Verify the grounding of the equipment and associated neutral (system ground) if applicable.
- (8) Conduct infrared test on all main current carrying equipment for hot spots that may indicate overload conditions or loose connections. Perform this test with the generator running.
- b. Generators.* Generator insulation testing and load testing are key elements of an effective maintenance program.
- (1) Generator insulation tests shall be performed as described below.
- (a) Perform insulation resistance tests using a megohmmeter in accordance with Institute of Electrical and Electronic Engineers (IEEE) 43, Recommended Practice for Testing Insulation Resistance of Rotating Machinery (2000) on the stator and rotor of both generator and exciter.
 - (b) Perform dielectric absorption testing using a megohmmeter.
 - (c) On generators operating at nominal 5 kV and above, a direct current (DC) overpotential test of the insulation should be performed.
- (2) Standby generators should be load-tested every two weeks with a minimum of 50 percent load and for at least one (1) hour after the unit reaches a stable temperature. Prime power generators and standby generators should be load-tested after maintenance has been performed. The load tests shall record frequency and voltage output, and verify instrumentation for correct indications.
- (3) Generator alignment and bearings shall be inspected as described below.
- (a) Inspect bearings.

- (b) Verify bearings are properly lubricated using lubricant recommended by the manufacturer.
 - (c) Perform vibration tests.
 - (d) Check alignment and couplings.
 - (e) Some generators have bearings electrically isolated from the pedestal. If applicable, verify isolation with an ohmmeter.
- (4) Using a true rms ammeter, measure the neutral current while generator is operating with site load. If amperage is abnormal, investigate for load imbalances and harmonics.
- c. Generator switchgear.* For preventive maintenance of switchgear, refer to the applicable switchgear sections of either the primary electrical distribution or secondary electrical distribution chapters, chapter 20 and 21, respectively.
- d. System controls.* System controls shall be calibrated and exercised as described below.
- (1) Using calibrated test instruments, calibrate ammeters, voltmeters, etc. Verify continuity of metering selector switch contacts with ohmmeter.
 - (2) Remove debris, dirt, and other foreign objects from all areas and components within the control panels.
 - (3) Programmable controllers, personal computers, microprocessors, etc., may be provided with diagnostic programs which should be run. Investigate and correct errors.
 - (4) Because of the complexity, number of, and variety of automatic sequences, it is not within the scope of this manual to describe specific tests. Simulation of control sequences should be all-inclusive to the extent that personnel are confident the control system will respond correctly should an actual similar event occur. An example of this simulation would be to simulate the loss of normal power to a site having standby generation. This loss of power should command the generators to start, etc.
 - (5) Actuate each alarm input for the correct response. Use corrective measures as required.
 - (6) For systems that have two or more generators operate the system for all modes with one generator off-line to simulate failure to start and parallel. Repeat for each generator in the system. Note: Ensure that remaining generators can carry the connected load prior to running tests.

Table 19-1. Typical generator maintenance

| Typical Generator Maintenance | |
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| Action | Frequency |
| <p style="text-align: center;">WARNING!</p> <p style="text-align: center;">MAINTENANCE PERSONNEL SHALL LOCKOUT/TAG EQUIPMENT TO ENSURE DE-ENERGIZATION DURING MAINTENANCE PROCEDURES.</p> | |
| Review maintenance records. | 2 wks |
| Review operator records. | 2 wks |
| Inspect equipment for the following: | |
| Inspect to ensure that warning signs exist. Replace as required. | 2 wks |
| Inspect enclosures for damage, unauthorized openings, and corrosion of metallic objects. Repair and paint as required. | 2 wks |
| Inspect air passages and remove any blockage. | 2 wks |
| Inspect, investigate, and solve conditions for unusual odors. | 2 wks |
| As equipment is operated and tested, listen, investigate, and solve conditions for unusual noises. | 2 wks |
| Inspect electrical connections for degradation. Repair as required. | 2 wks |
| Inspect electrical insulation for discoloration and degradation. Repair as required. | 2 wks |
| Inspect, investigate, and solve conditions causing carbon tracks. | 2 wks |
| Inspect equipment grounding components such as conductors and connections. Repair as required. | 2 wks |
| Inspect insulators for damage. Replace as required. | 2 wks |
| Inspect locking devices. Repair as required. | 2 wks |
| Clean equipment. | yr |
| Tighten electrical connections. | yr |
| Verify space heater operation. | yr |
| Verify equipment grounding. | yr |
| Perform infrared tests. | yr |

Table 19-2. Generators

| Generators | |
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| <i>Action</i> | <i>Frequency</i> |
| <p style="text-align: center;">WARNING!</p> <p style="text-align: center;">MAINTENANCE PERSONNEL SHALL LOCKOUT/TAG EQUIPMENT TO ENSURE DE-ENERGIZATION DURING MAINTENANCE PROCEDURES.</p> | |
| Test generator insulation. | |
| Perform insulation resistance tests using a megohmmeter in accordance with IEEE 43 on the stator and rotor of both generator and exciter. | yr |
| Perform dielectric absorption testing using a megohmmeter. | yr |
| On generators operating at nominal 5 kv and above, a DC overpotential test of the insulation should be performed. | yr |
| Load test generator. | |
| Load test standby generators with a minimum of 50 percent load for at least one (1) hour after the unit reaches a stable temperature. | 2 wks |
| Load test prime power generators and standby generators after maintenance has been performed. | as req'd |
| Verify frequency and voltage output. | 2 wks/as req'd |
| Verify instrumentation for correct indications. | 2 wks/as req'd |
| Check alignment and bearings | |
| Inspect bearings. | yr |
| Verify bearings are properly lubricated using lubricant recommended by the manufacturer. | yr |
| Perform vibration tests. | yr |
| Check alignment and couplings. | yr |
| Some generators have bearings electrically isolated from the pedestal. If applicable, verify isolation with an ohmmeter. | yr |
| Measure and record neutral current. | yr |

Table 19-3. System controls

| System Controls | |
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| <i>Action</i> | <i>Frequency</i> |
| <p style="text-align: center;">WARNING!</p> <p style="text-align: center;">MAINTENANCE PERSONNEL SHALL LOCKOUT/TAG EQUIPMENT TO ENSURE DE-ENERGIZATION DURING MAINTENANCE PROCEDURES.</p> | |
| Calibrate control system metering. | |
| Using calibrated test instruments, calibrate ammeters, voltmeters, etc. | yr |
| Verify continuity of metering selector switch contacts with ohmmeter. | yr |
| Clean control panel. | yr |
| Run controller diagnostics. | 6 mos |
| Simulate automatic control. | 6 mos |
| Verify alarms. | yr |
| Simulate parallel generator failure. | yr |